Scientific Inquiry

PS-1 The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.

PS-1.1 Generate hypotheses on the basis of credible, accurate, and relevant sources of scientific information.
Taxonomy Level: 6.1-B Create Conceptual Knowledge

Key Concepts: hypotheses, sources of scientific information

Previous/Future knowledge: Students were introduced to a hypothesis in 5th grade (5-1.1) as students identified questions suitable for generating a hypothesis. A more in-depth understanding of the processes and importance of using credible, accurate, and relevant sources of scientific information is expected for Physical Science. Generating hypotheses is the basis for conducting scientific investigations and is therefore vital to the understanding of the scientific inquiry process in Physical Science and all high school science courses.

It is essential for students to

- Know that a hypothesis is a reasonable explanation of an observation or experimental result or a possible answer to a scientific question that can be tested. The hypothesis may or may not be supported by the experimental results. It is often stated in terms of an independent and a dependent variable—or a "cause-effect relationship." Examples of hypotheses might include:
  - If an object has greater surface area, then the rate at which it falls through the air decreases.
  - As the volume of an object increases, the rate at which it fall through air decreases.
  - With a constant force, an object with a smaller mass will accelerate more than an object with a larger mass.
  - If I make a paper airplane with larger wings, then the airplane will glide farther, because the additional surface area of the wing will produce more lift.
- Know that the results of an experiment cannot prove that a hypothesis is correct. Rather, the results support or do not support the hypothesis. Valuable information is gained even when the hypothesis is not supported by the results. For example, it would be an important discovery to find that the wing size is not related to how far an airplane glides. When hypotheses are tested over and over again and not contradicted, they may become known as laws or principles.
- Use *credible* (trustworthy), *accurate* (correct – based on supported data), and *relevant* (applicable, related to the topic of the investigation) sources of scientific information in preparation for generating a hypothesis. These sources could be previous scientific investigations science journals, textbooks, or other credible sources, such as scientifically reliable internet sites.

Teacher Note:

Some sources of information are not based on credible scientific research and may contain information that is not accurate. Credible science investigations are published in journals that are reviewed by a panel of respected research scientists active in the field of science being studied. Teachers could help students identify credible sources of scientific information that may help them with background information for their hypotheses. Teachers must also caution students to be skeptical of website information and journal articles that are not referenced to credible sources of scientific research.

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It is not essential for students to

- Reference research from outside sources for every hypothesis written, but if scientific information is needed for generating a hypothesis, it must be credible, accurate, and reliable;
- Name specific journals or websites, but the understanding of what makes a source credible and reliable is part of this indicator;
- Understand the concept of the null hypothesis.

Assessment Guidelines:

The objective of this indicator is to *generate* hypotheses on the basis of credible, accurate, and relevant sources of scientific information, therefore, the primary focus of assessment should be for students to formulate a credible hypothesis for an investigation. Students must have an understanding of how the relationship between the independent and dependent variables are related in a hypothesis.

In addition to *generate*, assessments may require that students:

- *Identify* the variables involved in a hypothesis;
- *Use* data to determine whether a hypothesis was supported or not supported by that data;
- *Summarize* the criteria by which scientific information would be used to help generate the hypothesis.